State of Oregon
Department of Environmental Quality Memorandum

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To: **Matt McClincy, DEQ Project Manager**

From: **Paul Seidel, NWR Region Toxicologist**

Through: **Jennifer Peterson NWR Toxicologist**

Subject: **Development of Perchlorate Ecological Screening Criterion for Aquatic Life**

The purpose of this memorandum is to present the results of an evaluation to determine a defensible criterion for use as a screening level criterion for the protection of Aquatic Life. Although this work was done to support screening assessment at the Atofina Facility, ECSI # 398, the value is more generally applicable and could be used elsewhere.

Previous Evaluations and Literature Search

To support possible criteria development literature searches were performed to identify relevant toxicological studies. Databases searched were Toxline and EPAs EcoTox database. Additionally, the US EPA web site was searched for relevant publications. Generally, this search revealed that relatively little information is available on the aquatic toxicology of perchlorate. Most of the toxicology literature on perchlorate deals with exposures to mice and rats. This data is typically used in human health evaluations but is not useful for aquatic evaluations. US EPA prepared a comprehensive review of perchlorate toxicology including a review of literature available at that time (US EPA 2002). In addition, two new relevant studies were identified evaluating developmental effects in amphibians (Goleman et. al, 2002a, 2002b).

Criteria Development

A variety of benchmarks are potentially useful for ecological screening (Suter 1996). The most commonly used for this purpose are the National ambient water quality criteria (AWQC) (Stephan 1985). However, development of AWQC requires acute toxicity data from at least 8 separate taxa. When this level of data are unavailable, methodology is available to calculate what are referred to as Tier II values. The values are defined as concentrations that would be expected to be higher than the AWQC in no more than 20% of the cases, if sufficient data were obtained to calculate an AWQC (Suter and Tsao 1996, Suter 1996).

US EPA in their 2002 review of perchlorate toxicity derived Tier II values. The secondary acute and chronic values were 5 and 0.6 mg/L, respectively. The details on the derivation are attached to this memorandum as Attachment A. This derivation did not include the new amphibian data

published by Goleman et. al. 2002a,b. Therefore the Tier II calculation was repeated including the new data. The steps for calculation of the Tier II values are shown below.

Step 1. Take the lowest genus mean acute value (GMAV) for any of the genera present. From the available data, this is the *Ceriodaphnia* LC 50 of 66 mg/L.

Step 2. Divide this by the Final Acute Factor from table B.1 of Suter and Tsao 1996 to derive the secondary acute value (SAV). Since three genera have acute values available (*Ceriodaphnia*, *Pimephales* and *Xenopus*) the selected value from Table B.1 is 8.6. The resulting calculation is: SAV = 66 / 8.6 = 7.7 mg/L.

Step 3. Acute to Chronic ratios (ACRs) are calculated for each of the three genera. For Xenopus this is 20,529 (i.e. NOEC = 0.002 and LOEC = 0.0059, chronic value = 0.011). Thus, LC 50 / chronic value = 20,529. The other two ACRs can be taken from Attachment A. Thus, the three ACRs are 3.6, 8 and 2059.

Step 4. Derive the secondary acute to chronic ratio (SACR) by taking the geometric mean of the three ACRs. This result is 39.

Step 5. Derive the secondary chronic value (SCV) by dividing the secondary acute value by the secondary acute to chronic ratio (SACR). This results in a SCV of 0.2 mg/L.

Thus, the inclusion of the recent amphibian data and recalculation results in a higher SAV of 7.7 and a lower SCV or 0.2 mg/L. It should be noted that AWQC and Tier II values are not intended to be protective for all species (Suter 1996). Rather they are protected of the majority of species tested. This can be illustrated by the fact that the derived SCV of 0.2 mg/L is still nearly an order of magnitude higher than the amphibian Lowest Observed Effect Level (LOEL) of 0.059 mg/L from Goleman et. al. 2002a. Based on the foregoing, an understanding of the site to which these values are to be applied is important. If the presence of amphibians is suspected, the Tier II values may be inappropriate screening values. In these cases, the amphibian LOEL should be used.

References:

Suter

Stephan

Suter and Tsao

Goleman

Goleman
US EPA 2002